RGV100HL

High-Speed, High-Torque Precision Rotation Stage

Newport®
Experience | Solutions

USER'S MANUAL

For Motion, Think Newport™

Warranty

Newport Corporation warrants this product to be free from defects in material and workmanship for a period of 1 year from the date of shipment. If found to be defective during the warranty period, the product will either be repaired or replaced at Newport's discretion.

To exercise this warranty, write or call your local Newport representative, or contact Newport headquarters in Irvine, California. You will be given prompt assistance and return instructions. Send the instrument, transportation prepaid, to the indicated service facility. Repairs will be made and the instrument returned, transportation prepaid. Repaired products are warranted for the balance of the original warranty period, or at least 90 days.

Limitation of Warranty

This warranty does not apply to defects resulting from modification or misuse of any product or part.

CAUTION

Warranty does not apply to damages resulting from:

- **Incorrect usage:**
  - **Load on the stage greater than maximum specified load.**
  - **Carriage speed higher than specified speed.**
  - **Improper grounding.**
    - ¬ **Connectors must be properly secured.**
    - ¬ **When the load on the stage represents an electrical risk, it must be connected to ground.**
  - **Excessive or improper cantilever loads.**
- **Modification of the stage or any part thereof.**

CAUTION

Please return equipment in the original (or equivalent) packing.

You will be responsible for damage incurred from inadequate packaging if the original packaging is not used.

This warranty is in lieu of all other warranties, expressed or implied, including any implied warranty of merchantability or fitness for a particular use. Newport Corporation shall not be liable for any indirect, special, or consequential damages.

No part of this manual may be reproduced or copied without the prior written approval of Newport Corporation.

This manual has been provided for information only and product specifications are subject to change without notice. Any changes will be reflected in future printings.

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EC Declaration of Conformity

RGV100HL

Newport
Experience | Solutions

EC Declaration of Conformity

following Annex II-1A
of Directive 2006/42/EC on machinery

The manufacturer:

MICRO-CONTROLE Spectra-Physics,
9, rue du Bois Sauvage
91055 Evry CEDEX, FRANCE

Hereby declares that the machinery:

- Description: " RGV100HL "
- Function: High-Speed, High-Torque Precision Rotation Stage
- Models: RGV100HL

– the technical file of which was compiled by:

Mr Dominique DEVIDAL, Quality Director,
MICRO-CONTROLE Spectra-Physics, Zone Industrielle - B.P.29
F-45340 Beaune La Rolande France

– complies with all the relevant provisions of the Directive 2006/42/EC on machinery.
– complies with all the relevant provisions of the Directive 2004/108/EC relating to electro-magnetic compatibility.

– was designed and built in accordance with the following harmonised standards:

- NF EN 61326-1:2006 « Electrical equipment for measurement, control and laboratory use – EMC requirements – Part 1: General requirements »
- NF EN 55011:2007 Class A

– was designed and built in accordance with the following other standards:

- NF EN 61000-4-2
- NF EN 61000-4-3
- NF EN 61000-4-4
- NF EN 61000-4-6

ORIGINAL DECLARATION

Done in Beaune La Rolande on 13 February 2013
Dominique DEVIDAL
Quality Director

DC1-EN rev:A

Definitions and Symbols

The following terms and symbols are used in this documentation and also appear on the product where safety-related issues occur.

General Warning or Caution

The exclamation symbol may appear in warning and caution tables in this document. This symbol designates an area where personal injury or damage to the equipment is possible.

The following are definitions of the Warnings, Cautions and Notes that may be used in this manual to call attention to important information regarding personal safety, safety and preservation of the equipment, or important tips.

WARNING

Warning indicates a potentially dangerous situation which can result in bodily harm or death.

CAUTION

Caution indicates a potentially hazardous situation which can result in damage to product or equipment.

NOTE

Note indicates additional information that must be considered by the user or operator.

European Union CE Mark

The presence of the CE Mark on Newport Corporation equipment means that it has been designed, tested and certified as complying with all applicable European Union (CE) regulations and recommendations.

Warnings and Cautions

ATTENTION

This stage is a Class A device. In a residential environment, this device can cause electromagnetic interference. In this case, suitable measures must be taken by the user.

WARNING

When the RGV100HL stage is installed or combined with other instruments in a machine, additional testing to directive 2006/42/EC may be required. It is the responsibility of the end-user or integrator to perform a risk-analysis and the necessary tests to conform to the EC directives.

Newport is not liable for damages caused by not executing this responsibility.

Warnings

WARNING

The rotation of objects of all types presents potential risks for operators. Protect the operators by prohibiting access to the pinch points marked by the icon on the left. Supplement this with personnel training of the potential risks involved.

WARNING

The connection of electrical devices must meet safety and electrical standards. Grounding methods indicated in this manual must be applied.

WARNING

Due to the nature of this stage, the installation, use and maintenance of this stage must be performed by trained personnel who are familiar with safety regulations that are applicable to this product.

WARNING

Do not use the RGV100HL stage if any abnormal activity is observed. The stage should not be used if the motor is hot to the touch, emitting smoke, emitting an odor, or is unusually noisy.

Stop using the stage immediately, switch off the motor power and then disconnect the power source from the control electronics.

In the event of a failure described above, please contact your Newport service facility and request repairs. Never attempt to repair the stage yourself, as this can be dangerous.

WARNING

Make sure that this stage is not exposed to moisture and that liquid does not get into the stage.

Nevertheless, if any liquid has entered the stage, switch off the motor power and then disconnect the electronics from power source.

Contact your Newport service facility and request repairs.

WARNING

Do not insert or drop objects into the stage, this may cause an electric shock, or lock the drive.

Do not use this stage if any foreign objects have entered the stage. Switch off the motor power and then disconnect the power source from the electronics.

Contact your Newport service facility for repairs.

WARNING

Do not place this RGV100HL stage in unstable locations such as on a wobbly table or sloping surface, where it may fall or tip over and cause injury.

If this stage has been dropped or the case has been damaged, switch off the motor power and then disconnect the electronics from the power source.

Contact your Newport service facility and request repairs.

WARNING

Do not attempt to modify this stage; this may cause an electric shock or degrade performance.

WARNING

Do not exceed speed and load limitations as specified in this manual.

WARNING

Do not exceed the usable depth indicated on the mounting holes (see section "Dimensions"). Longer screws can damage the mechanics or cause a short-circuit.

Cautions

CAUTION

Do not place this RGV in a hostile environment such as X-Rays, UV, or in vacuum. Improper use of this rotation stage may cause damage and voids the warranty.

CAUTION

Do not place this RGV in a location with dust, oil fumes or steam. This may cause an electric shock.

CAUTION

Do not leave this stage in places subject to extreme temperatures. This can damage electronics, degrade mechanics and is an electric shock hazard.

- **Operating temperature: +10 to +35 °C.**
- **Storage/Operating Altitude: 1000 m**
- **Storage/Operating Humidity: 85%**
- **Storage temperature: -10 to +40 °C (in original packaging).**

CAUTION

Do not move this RGV if the power is on.

Make sure that cables to the controller are disconnected before moving the rotation stage. Failure to do so may damage cables and/or cause an electrical shock.

CAUTION

Be careful that the RGV is not bumped when it is being carried. This may cause it to malfunction.

CAUTION

Before handling this RGV, always unplug the equipment from the power source for safety.

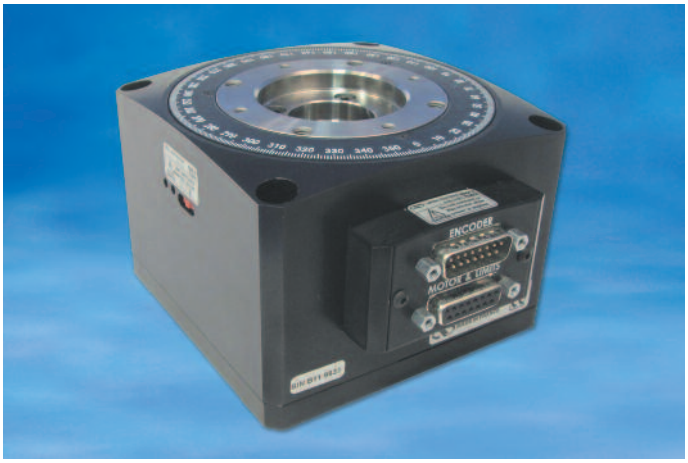
CAUTION

Contact your Newport service facility to request annual maintenance.

High-Speed, High-Torque Precision Rotation Stage RGV100HL

1.0 Introduction

This manual provides operating instructions for the RGV100HL high-speed, high-torque precision rotation stage.



RGV100HL precision rotation stage.

RECOMMENDATION

Read the chapter “Connection to electronics” before using the RGV100HL rotation stage.

2.0 Description

The RGV100HL is the high torque version of the RGV100BL, a very compact direct-drive rotation stage that provides ultra-fast rotation with very high resolution and outstanding positioning performance. Applications include semiconductor wafer inspection, micro-robotics, and precision metrology.

The direct-drive technology of the RGV100HL eliminates the worm gear of traditional rotation stages. The advantages are higher speeds, superior reliability, and enhanced position sensitivity. Speed, resolution, and repeatability are increased by a factor of up to ten times compared to worm-driven rotation stages of the same size. A high efficiency brushless DC torque motor with rare earth magnets supplies an optimum ratio of torque vs inertia for high acceleration, with minimal stage heating.

Precision is ensured by a high-resolution glass scale with 15,000 line pairs per revolution that directly measures the position of the rotating platen. The flat encoder is mounted on a precision ground reference surface and is perfectly aligned with the stage's rotation axis to minimize position errors induced by eccentricity, wobble, or axial runout. The encoder signals are interpolated by Newport's XPS motion controller with less than 0.1 mdeg resolution for outstanding position sensitivity and stability.

The RGV100HL features a proprietary 4-point contact ball bearing. This unique, 2-piece design takes the full benefit of Newport's excellent capabilities in the design, manufacturing and assembly of precision mechanics and integrates multiple functions, the bearing ways and the direct drive motor into a minimum number of parts. The result is a more compact rotation stage with superior stiffness, high reliability and outstanding wobble and eccentricity.

A 30 mm diameter through-hole allows convenient routing of cables and vacuum lines through the stage. An index pulse, triggered every revolution, permits precision homing to a unique home position. The RGV100HL also features two limit switches that can be enabled or disabled by an external switch.

3.0 Stage Installation

3.1 Unpacking

The RGV100HL stage is delivered in packaging designed for safe transport. Carefully lift the stage from packaging and handle with care.

The stage comes with a test report that shows the stage performs within the guaranteed specifications. These measurements were taken in a controlled environment under flat mounting conditions.

3.2 Mounting Conditions

The RGV100HL stage features a four-point mounting surface. The compactness of its body provides good stiffness, however it is recommended that the mounting conditions below be followed for best performance.

Installation Considerations	
Mounting surface flatness	10 µm
Payload surface flatness	10 µm
Max. M6 mounting screw torque	7 Nm
Max. M5 mounting screw torque	4 Nm

4.0 Connection to Newport Controllers

NOTE

Visit www.newport.com for compatible Newport controllers.

4.1 Operating with Newport Controllers/Drives

Newport provides detailed documentation for connecting and configuring RGV100HL stages with compatible Newport controllers/drives. Newport controllers proprietary plug-and-play ESP technology will automatically load configuration parameters for the stage based on best factory settings in a no load condition. These configurations can be adjusted for optimal operation under various applications and load conditions. Refer to documentation available on the RGV100HL Page for additional information.

4.2 Warnings on Controllers

Controllers are intended for use by qualified personnel who recognize shock hazards and are familiar with safety precautions required to avoid possible injury. Read the controller user's manual carefully before operating the instrument and pay attention to all written warnings and cautions.

Specifications listed in this guide are based on operation with Newport Control and Drive Electronics. The Newport controllers with ESP technology are delivered with a configuration file that has been developed at the factory for operation in a no-load condition for immediate plug-and-play operation.

WARNING

Disconnect the power plug under the following circumstances:

- **If the power cord or any attached cables are frayed or damaged in any way.**
- **If the power plug is damaged in any way.**
- **If the unit is exposed to rain, excessive moisture, or liquids are spilled on the unit.**
- **If the unit has been dropped or the case is damaged.**
- **If you suspect service or repair is required.**
- **Whenever you clean the electronics unit.**

CAUTION

To protect the unit from damage, be sure to:

- **Keep all air vents free of dirt and dust.**
- **Keep all liquids away from the unit.**
- **Do not expose the unit to excessive moisture (85% humidity).**
- **Read this manual before using the unit for the first time.**

WARNING

All attachment plug receptacles in the vicinity of this unit are to be of the grounding type and properly polarized.

Contact your electrician to check your receptacles.

WARNING

This product operates with voltages that can be lethal.

Pushing objects of any kind into stage slots or holes, or spilling any liquid on the product, may affect voltage points or short out parts. Any unauthorized access to internal electronics represents a potential shock hazard and care should be taken.

4.3 Connection

On each stage, there is a label which indicates the stage name and serial number.

WARNING

Always turn the controller's power OFF before connecting or disconnecting to a stage.

WARNING

Ensure the stage is stopped before connecting or disconnecting. The rotation can generate voltages and currents dangerous for workers and for the equipment.

Stages may be connected to the rear panel motor connectors labeled “Motor…” at any time prior to power-up with the supplied cable assemblies.

NOTE

The RGV100HL is an ESP compatible stage. Enhanced System Performance is Newport's exclusive technology that enables Newport ESP compatible motion controllers to recognize the connected Newport ESP stage and upload the stage parameters. This ensures that the user can operate the motion system quickly and safely.

4.4 Cable

The RGV100HL stage is delivered with a set of two 5-meter cables that can be directly connected to the Newport controller.

WARNING

The RGV100HL rotation stage can only operate with cable lengths of 5 m or less.

WARNING

These cables are shielded. For correct operation, make sure to lock the connectors (ground continuity provided by cables).

WARNING

Keep the cables at a safe distance from other electrical cables in your environment to avoid potential cross talk.

5.0 Connection to Non-Newport Controllers

Newport stages can be operated with Non-Newport controllers. However, under such operational conditions Newport makes no guarantee regarding achievable specifications. To aid Newport customers using non-Newport Controllers with the RGV100HL stage we have provided wiring conventions and motor characteristics below. It should be noted, damage caused by improper configuration or operation while in use with non-Newport controllers is not covered by the warranty.

Please refer to Design Details and Specifications for more information to help configure the stage with your controller. Newport also provides a tech note on configuring third party stages with Newport controllers on the RGV100HL website, which may be useful as a reference.

WARNING

Newport takes no responsibility for improper function or damage to a stage when used with any non- Newport controllers.

6.0 Characteristics

6.1 Definitions

Specifications of our products are established in reference to ISO 230 standard part II “Determination of the position, precision and repeatability of the machine tools with CNC”.

This standard provides the definition of position uncertainty which depends on the 3 following quantities:

(Absolute) Accuracy

Difference between ideal position and real position.

On-Axis Accuracy

Difference between ideal position and real position after the compensation of linear error sources.

Linear errors include: cosine errors, inaccuracy of screw or linear scale pitch, angular deviation at the measurement point (Abbe error) and thermal expansion effects. All Newport motion electronics can compensate for linear errors.

The relation between absolute accuracy and on-axis accuracy is as follow:

Absolute Accuracy = On-Axis Accuracy + Correction Factor x Travel

Repeatability

Ability of a system to achieve a commanded position over many attempts. Can be specified as uni-directional or bi-directional.

Reversal Value (Hysteresis)

Difference between actual position values obtained for a given target position when approached from opposite directions.

Minimum Incremental Motion (Sensitivity)

The smallest increment of motion a device is capable of delivering consistently and reliably.

Resolution

The smallest increment that a motion device can theoretically move and/or detect. Resolution is not achievable, whereas MIM, is the real output of a motion system.

Eccentricity

Displacement of the geometric center of a rotation stage from the rotation axis in the plane defined by bearings.

Wobble

Tilt of rotation axis during rotation of a stage, measured on a reference surface. For the RGV100HL stage, the flatness of this reference surface is ≤10 µm (see chapter: “Dimensions and Mounting”).

The testing of on-axis accuracy, repeatability, and hysteresis are made systematically with our test equipment in a controlled environment (20 °C ±1 °C).

The test is comprised of 4 cycles, each taking 21 data points in the forward and reverse directions, for a total of 164 data points.

6.2 Design Details

Base Material	Aluminum
Bearings	Large diameter steel ball bearings
Motor	High-torque brushless DC motor with rare earth magnets (no Hall effect sensors)
Motor Initialization	Has to be done by the controller (without using Hall effect sensors)
Motor Commutation	Done by the XPS controller on encoder signals
Feedback	Glass scale encoder with 15,000 line pairs per revolution, 1 Vpp, 32768-fold signal subdivision when used with XPS controller
Limit Switches	Two optical limit switches at approx. ±168°, disabled by external switch No hard stops included
Origin	Optical, fixed at position 0°, including mechanical zero signal
ESP Compatibility	Yes
Cable Length (m)	5 (included)

NOTE

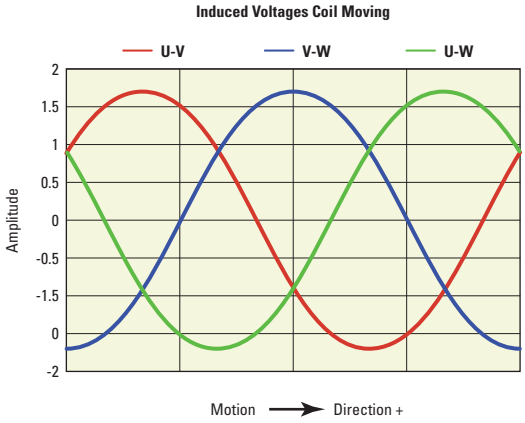
This product complies with the RoHS directive (Restriction of Hazardous Substances)

6.3 Motor characteristics (Direct Drive Brushless Motor)

Magnet pitch (Commutation period)	30°
Motor constant	0.115 Nm^2/W
Torque sensitivity	1.48 Nm/Arms
Back-emf constant	1.207 V/rad/s
Motor resistance	12.61 Ω
Motor inductance	31.4 mH
Thermal resistance	1.5 °C/W
Max. speed @ Max. voltage	81 rad/s @ 100 V
Peak current	5.6 Arms
Peak torque	8.3 Nm
Max. rms current	1.38 Arms
Max. rms torque	2.05 Nm

CAUTION

High RMS current will generate motor heating which will degrade characteristics of the stage, including such attributes as repeatability, accuracy, etc...

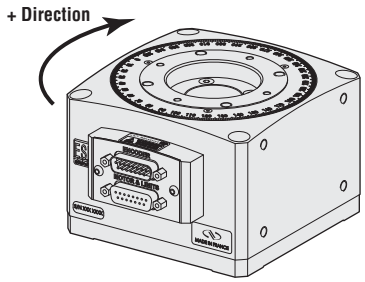


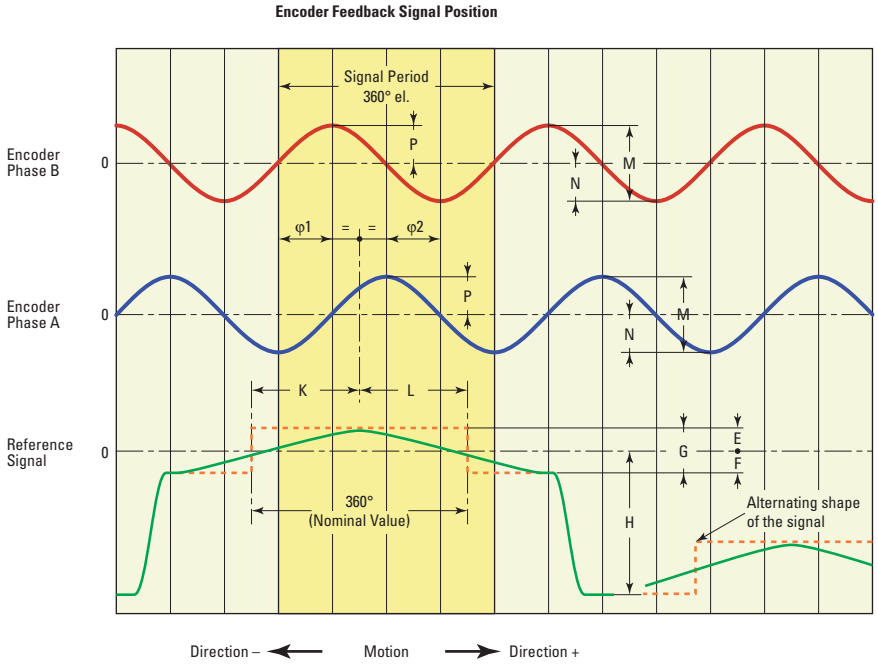
NOTE

The values above indicate induced voltage between coils. A positive value for U-V would indicate a higher voltage on U relative to V.

6.4 Encoder

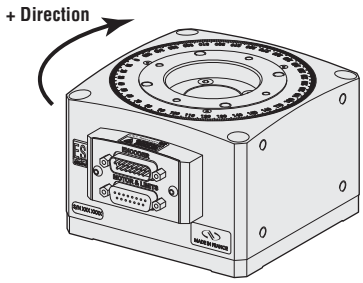
Power supply	5 VDC ±5% @ 33 mA
Output signal	Sine/Cosine
Resolution	15000 lines/rev.

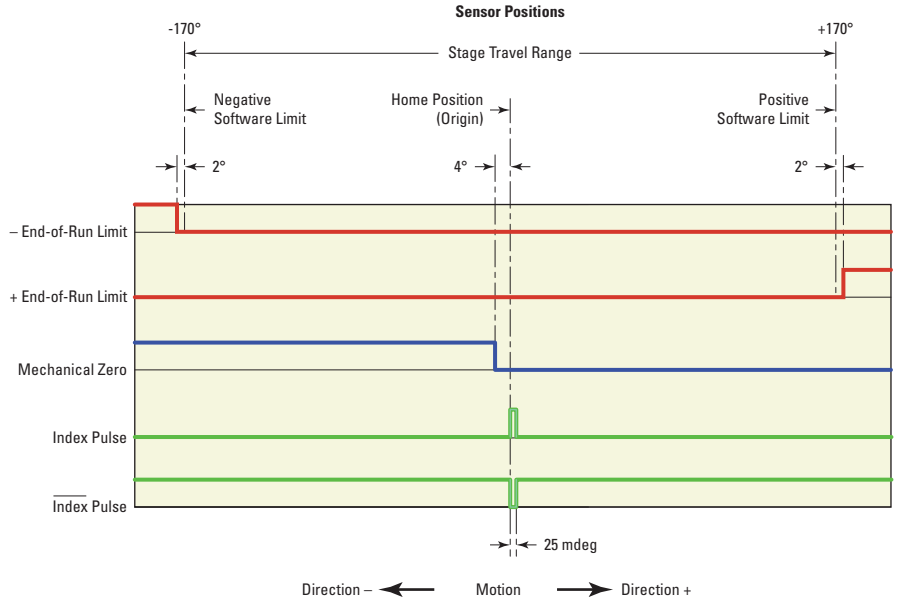




Interface	Sinusoidal voltage signals	1 VDC
Incremental signals	2 signals with sinusoidal shape, A and B	
	Signal range, M:	0.6 to 1.2 VDC; 1 VDC typical
	Gap of symmetry |P - N|/2M	≤0.065
	Signal ratio M_A/M_B:	0.8 to 1.25
	Phase difference |φ1 + φ2|/2:	90° ±10° el.
Reference signal	1 or several peaks of signal, R	
	Usable range, G:	≥0.2 V
	Sleeping value, H:	≥1.7 V
	Signal/Noise ratio, E and F:	0.04 to 0.68 V
	Zero crossing, K and L	180° ±90° el.

6.5 Sensor Positions





6.6 Mechanical Specifications

Travel Range (°)	360 continuous
Minimum Incremental Motion (°)	0.00011
Uni-directional Repeatability, Guaranteed [1] (°)	0.0003
Bi-directional Repeatability, Guaranteed [1] (°)	0.0011 or ±0.00055
Absolute Accuracy, Guaranteed [1] (°)	0.01 or ±0.005
Max. Speed (no load) [4] (°/s)	720
Min. Scan Speed (°/s)	1 [2]
Peak Torque, Mz (Nm)	9.65
Max. Continuous Torque (Nm)	1.43
Inertia (no load) (kg.m^2)	0.0012
Max. Inertia [3] (kg.m^2)	0,032
Wobble, Guaranteed [1] (µrad)	40 or ±20
Eccentricity, Guaranteed [1] (µm)	3 or ±1.5
MTBF (h)	20,000 with 5 kg load, 720 °/s speed and a duty cycle of 30%
Weight [lb (kg)]	Stage: 7.7 (3.5) 5-meter encoder cable: 0.84 (0.38) 5-meter motor cable: 1.72 (0.78)

[1] Shown are peak to peak, guaranteed specifications or ± half the value as sometimes shown. Typical specifications are about 2X better than the guaranteed values.

[2] For lower scan speed, contact us.

[3] The default set of parameters permits the use of the rotation stage from no load up to the recommended max. inertia divided by two, without changing parameters. The recommended max. inertia corresponds to an easy and optimum use of the rotation stage. For higher inertia, contact us.

[4] Depend on driver.

NOTE

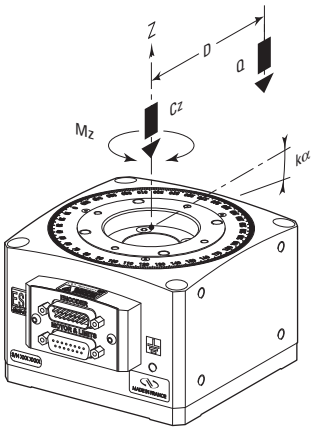
The following specifications are controller/drive dependent. Refer to the RGV100HL page on www.newport.com for specifications achievable with specific Newport controller/drive combination.

- **MIM**
- **Accuracy**
- **Repeatability**
- **Max Speed**
- **Max Acceleration**

CAUTION

To achieve the specifications stated, stages must be fixed on a plane surface with a flatness of 10 µm.

6.7 Load Capacity (Cz)



Cz, Normal centered load capacity	100 N
Kα, Transversal compliance	15 µrad/Nm
Jz, Maximum Inertia	0.032 kgm^2
Q, Off-center load	Q ≤ Cz/(1+D/35) and Q ≤ (Jz-Jq)/D^2

Where: D = Cantilever distance in mm
Jq = Inertia of payload

CAUTION

When a RGV100HL rotation stage is integrated in an assembly or in a system, vibration due to the rotation of an off-center load at a high speed must be taken into account.

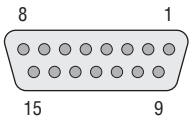
These events can affect the RGV100HL's performance and the system's performance, or damage the stage and assembly.

7.0 Connectors and Cables

7.1 Pinouts

Sub-D pin outs for the RGV100HL stage are provided in the following tables:

Motor & Limits Connector (P1 – Sub-D15 Female)



1	N.C.
2	Phase V Motor
3	Mechanical Zero
4	- End-of-Run
5	Ground
6	N.C.
7	N.C.
8	N.C.
9	Phase W Motor
10	Phase U Motor
11	+ End-of-Run
12	N.C.
13	N.C.
14	N.C.
15	N.C.

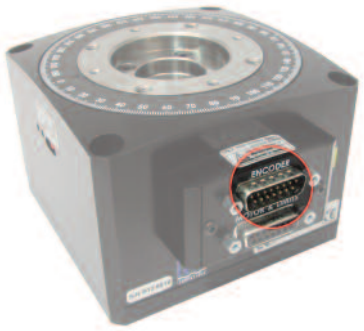
- Max. voltage: 96 V
- Max. rms Current: 1.38 A

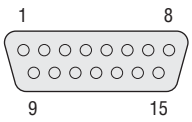
WARNING

GROUNDING: The stage's protective ground is located on pin #5 of the motor power connector.

If you are using grounds other than those provided by Newport, you must connect pin #5 to a ground connection.

Encoder Connector (P2 – Sub-D15 Male)





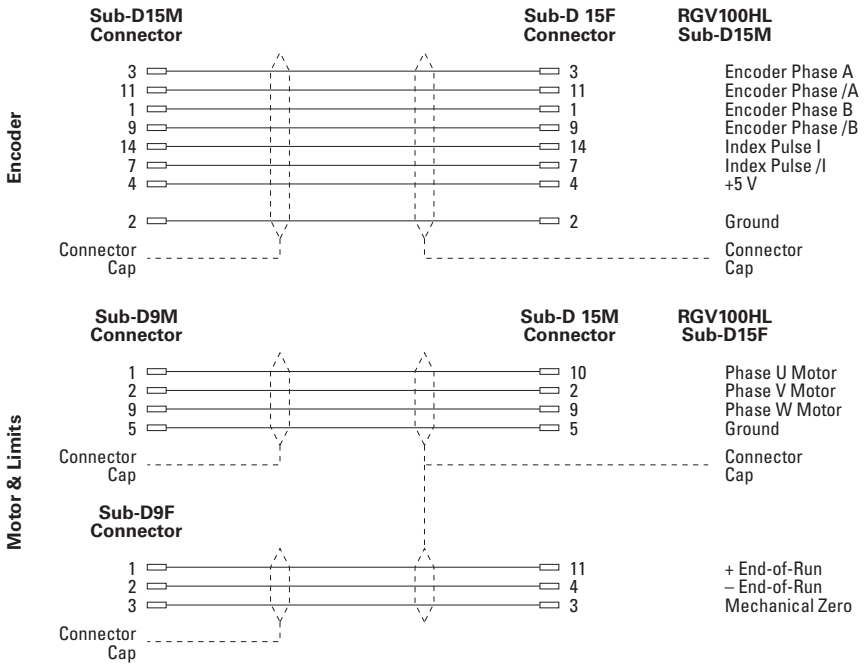
1	Encoder Phase B
2	Ground
3	Encoder Phase A
4	Encoder Power: + 5 V
5	N.C.
6	N.C.
7	Index Pulse /I
8	N.C.
9	Encoder Phase /B
10	N.C.
11	Encoder Phase /A
12	N.C.
13	N.C.
14	Index Pulse I
15	N.C.

7.2 RGV100HL Cable Wiring

The RGV100HL stage is delivered with the two cables required for operation. The wiring diagrams and connectors for these cables are provided below. When operating with non-Newport controllers, it is recommended to adhere to the wiring conventions presented here and to use cabling with similar characteristics.

WARNING

Newport guarantees the "CE" compliance of the RGV100HL rotation stage only if it is used with a Newport cable and a Newport controller.



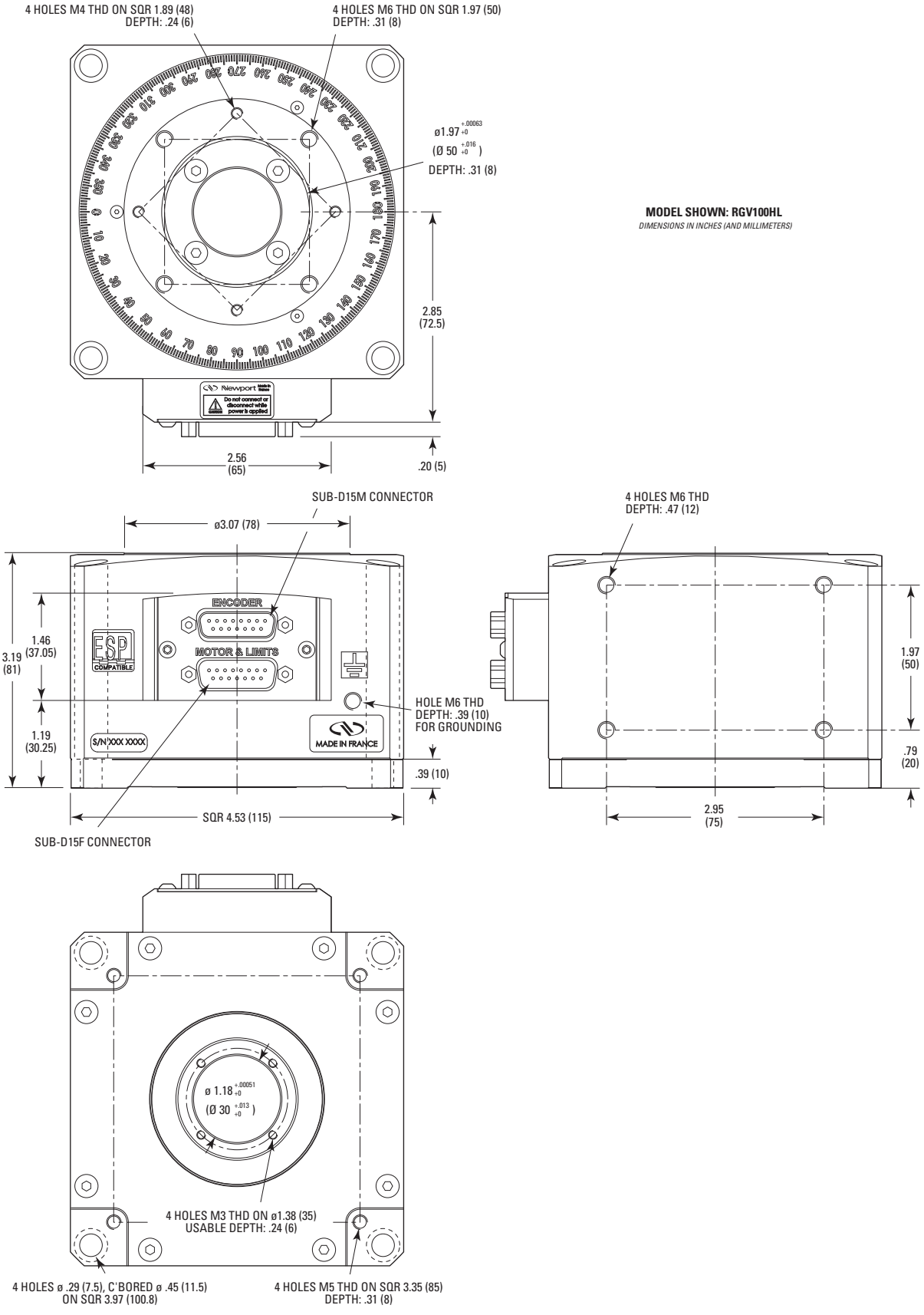
NOTE

This is the wiring of the cables used with Newport Controllers. For third party controllers, we recommend using a cable with similar characteristics: sections 7.1 (Pinouts) and 7.2 (RGV100HL Cable Wiring).

Encoder Cable.

Motor & Limits Cable.

8.0 Dimensions



9.0 Maintenance

RECOMMENDATION

Contact Service to determine the appropriate maintenance schedule for your application and duty cycle.

9.1 Maintenance

The RGV100HL rotation stage requires no particular maintenance. Nevertheless, this is a precision mechanical device that must be kept and handled with caution.

PRECAUTIONS

The RGV100HL rotation stage must be operated and kept in a clean environment, without dust, humidity, solvents or other substances.

RECOMMENDATION

It is recommended to return your RGV100HL every 2000 hours of use for lubrication.

If your RGV100HL rotation stage is mounted on a workstation and cannot be easily removed, please contact our After Sales Service for further instructions.

9.2 Repair

CAUTION

Never attempt to disassemble stage components, unless as directed in this manual.

Disassembly of a non-specified component can potentially cause a malfunction and damage to the stage.

If you observe a malfunction in your rotation stage, please immediately contact us to arrange for repair.

CAUTION

Any attempt to disassemble or repair this rotation stage without authorization will void the warranty.

9.3 Calibration

CAUTION

It is recommended to return your rotation stage to Newport once a year to verify and repair as need to meet its original specifications.

Service Form

Your Local Representative
Tel.: _____
Fax: _____

Name: _____ Return authorization #: _____
(Please obtain prior to return of item)

Company: _____

Address: _____ Date: _____

Country: _____ Phone Number: _____

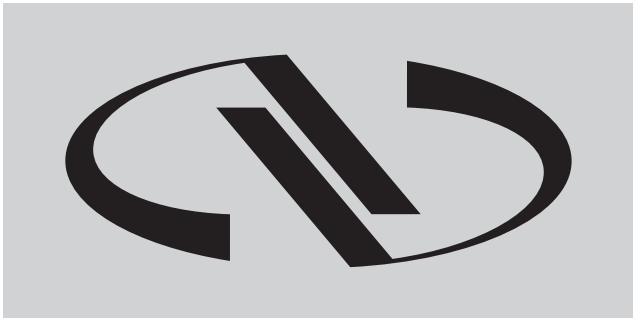
P.O. Number: _____ Fax Number: _____

Item(s) Being Returned:

Model #: _____ Serial #: _____

Description: _____

Reasons of return of goods (please list any specific problems): _____



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